

BRITISH COLUMBIA PROVINCIAL MUSEUM

HANDBOOK No. 2



THE AMPHIBIANS OF BRITISH COLUMBIA

By G. CLIFFORD CARL

VICTORIA, B.C.

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The Amphibians of British Columbia.

INTRODUCTION.

THE amphibians consist of a group of cold-blooded animals of considerable biological and economic interest. Members of the group are found in all parts of the world except in the very cold regions. In British Columbia they are represented by salamanders, toads, tree-toads, and frogs.

Some of these animals are often confused with lizards and other reptiles; while others, in the early stages of development, resemble fishes in some features. It is well, therefore, to point out the characteristics of the members of this group which distinguish them from all other similar animals.

Most amphibians start their life in water, hatching as a fish-like tadpole having a tail-fin for swimming and gills for breathing. Later, legs, lungs, and other organs appear, while the gills, tail-fin, and sometimes the tail disappear and the animal leaves the water to take up life on land, returning only to lay its eggs. Some amphibians, however, do not spend part of their life in water but hatch in the adult form from eggs laid on land. These terrestrial species, like their relatives which hatch in water, cannot live without moisture and consequently are never found far from damp localities.

Amphibians which begin their life as a tadpole in water resemble fish in several ways, such as in the possession of gills and tail-fin. They differ from fish, however, since they have no scales, nor fins on the side of the body, and also since they later develop legs and lungs and leave the water. Adult salamanders which have tails as well as legs resemble lizards in size and shape and are sometimes mistaken for these reptiles. However, they lack scales or bony plates and other less obvious anatomical features, such as a muscular diaphragm, which are present in reptiles. In addition, salamanders lay eggs usually in water or in a damp place and the young pass through a stage, during which they breathe by means of gills, while reptiles lay their

eggs on land in a relatively dry place or give birth to living young and do not pass through a gill-breathing stage.

Amphibians, therefore, come between fishes and reptiles in the tree of life and for this reason are especially interesting to biologists.

The term "salamander" as used in this booklet refers to all terrestrial and aquatic species, including the newt, which is sometimes called "water dog" and "water lizard." Salamanders differ from frogs and toads in having the front and hind legs of about equal length and in having a tail in the adult. They differ also in having no vocal cords, external ear membranes, nor webs between the toes—structures which are usually present in toads and frogs. Their tadpoles can be distinguished from frog and toad tadpoles by the elongated body and by the tufts of feathery gills at each side of the neck (Figure 1).

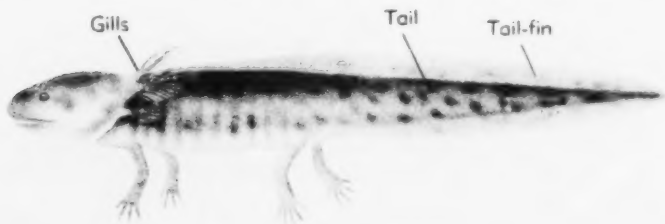


Figure 1. Salamander larva.

Toads, tree-toads, and frogs differ from salamanders in having the hind legs much longer than the front legs and in having no tail in the adult form. In addition, they usually have vocal cords, external ear membranes, and webs between the toes of the hind feet—structures which are lacking in the tailed amphibians. Tadpoles of toads and frogs, often called "pollywogs," have short, round bodies and no visible gills (Figure 2).

LIFE-HISTORY.

All salamanders, except the strictly terrestrial species, enter fresh water in the early spring to spawn. At this time there is usually a rather well-defined courtship of the female by the male, after which the male deposits a mucous-encased sac of sperm on the bottom or on

a water-plant. This sac, known as a "spermatophore," is picked up by the female by means of the lips of the cloaca and the sperms are stored within the body until the eggs are ready to be fertilized.

The eggs are laid singly or in masses, depending upon the species, and are usually attached to some support such as twigs, stems of grass, leaves, etc. Each egg is enclosed in a jelly-like capsule and, in the case where many eggs are laid together, all are enveloped in a gelatinous mass. Egg-masses of some species closely resemble those of the common tree-toad; in others, such as the Northwestern salamander, the mass is solid to the touch and about the size of a grapefruit.

The period of development in aquatic forms varies with the species and with the temperature of the water, but in general it averages about three weeks. Shortly after hatching, external gills and the

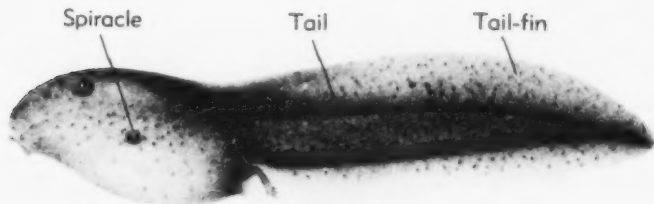


Figure 2. Frog tadpole.

front pair of legs are usually present as well as the strongly developed tail and tail-fin (Figure 1). In some species a pair of "balancers" is also present. These rod-shaped organs, one on either side of the neck, disappear a short time after hatching. The young salamanders are called "larvæ" since they must undergo a further change before becoming adults. During the larval period they are voracious feeders, preying upon all other living things small enough to swallow. In captivity they even attack each other, tearing off limbs or other parts of the body. In most species the larvæ grow rapidly and transform to the adult stage by the end of the first summer. In others the change does not take place until the second summer and sometimes later, depending possibly upon temperature and food.

In changing from the larva to the adult the gills and tail-fin are absorbed and lungs are developed, enabling the salamander to leave the water and to live on land. The process of transformation is called "metamorphosis."

In the case of terrestrial species which do not enter the water at any time, the eggs are laid in cavities in decaying wood or in other damp places. The eggs are much larger than those of the aquatic species, being about the size of a pea in the case of the Red-backed salamander, and are attached by individual stalks, giving the whole mass a grape-like appearance. It has been found in some species that the female remains coiled around the eggs during the incubation period.

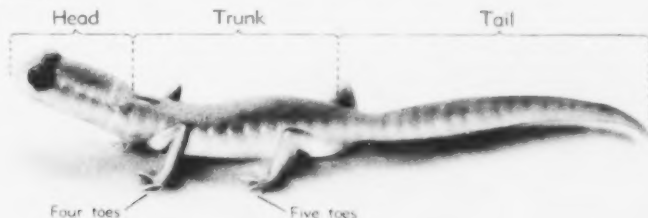


Figure 3. Structure of a salamander (Red salamander).

During the development within the egg the young terrestrial salamander goes through a larval stage much like the aquatic species, being provided with external gills for respiration. However, these accessory breathing organs disappear before hatching or shortly after, and the salamander emerges in the adult form. Some species do not develop lungs but depend upon their moist skin and throat-cavity for respiration.

The life-history of toads and frogs is much like that of the aquatic salamanders. In the spring or early summer most members of this group gather in ponds, sloughs, swamps, or lake edges and the males begin to croak in a chorus. When the female is ready to spawn she is grasped by the male who fertilizes the eggs as they are laid. The eggs are enveloped in a jelly-like substance and are laid in large or small masses or in strings, depending upon the species. In some cases

the eggs are attached to twigs, weeds, or other supports; in others they float at the surface or lie on the bottom.

In a week or so, the time depending upon the species and the temperature of the water, the tadpoles wriggle their way out of the jelly. At first they have external gills on the sides of the neck much like those in salamander larvæ. In addition each is provided with a small sucker beneath the mouth to enable the larva to cling to a water-plant or other support. Soon, however, the sucker is lost and a flap of skin grows backward, enclosing the gills in a chamber on either side of the neck. Water then enters the chamber by way of the mouth and leaves by way of a single opening on the left side called the "spiracle" (Figure 2). About the same time the mouth develops



Figure 4. Mouth of (A) Northwestern salamander, (B) Clouded salamander, and (C) Red-backed salamander; N=internal opening of nostril; V=vomerine teeth; P=Parasphenoid teeth; E=eyeball protuberance; and T=tongue.

horny jaws and teeth, enabling the tadpole to rasp off small particles of plant and animal tissue for food. As the tadpole grows, the body becomes rounded and the intestine becomes visible through the thin skin of the belly, appearing like the coiled hair-spring of a watch. About this time the hind legs, which first appear as bud-like growths at the base of the tail, grow rapidly while the front legs develop within the gill chamber. As the time for metamorphosis approaches,

lungs develop within the body-cavity and the gills gradually become absorbed, forcing the tadpole to the surface for air. The front legs then break through the gill-cover, the left one being thrust through the opening of the spiracle, the mouth widens and the eyes increase in size. At this stage the young frog or toad may leave the water. The tail-stub may persist a day or two but it is eventually absorbed, completing the metamorphosis.

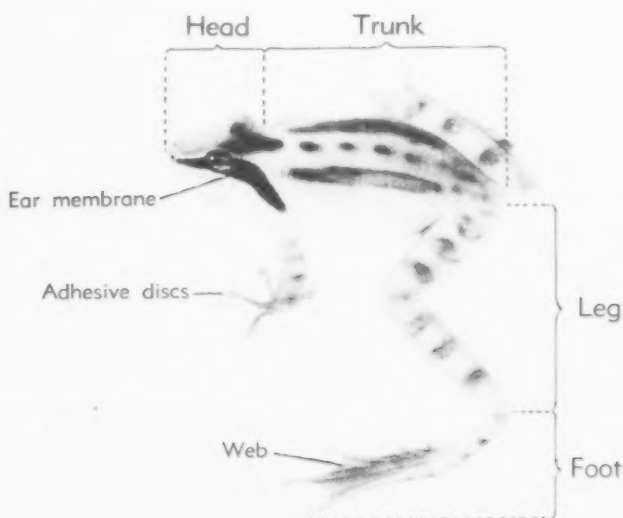


Figure 5. Structure of a frog (Pacific tree-toad).

STRUCTURE.

A salamander consists of three main parts—namely, head, trunk, and tail (Figure 3). The head is usually separated from the body by a distinct neck. The mouth is large, enabling the animal to swallow prey of some size. There are no true teeth present. Attached to the floor of the mouth is a flat, circular or oval tongue which can

be partly protruded and which helps in catching and holding food organisms. On the roof of the mouth are bony protuberances known as "vomerine teeth" and "parasphenoid teeth," which also aid in holding the prey before swallowing. In some species the vomerine teeth are arranged in two rows running obliquely between the orbits of the eyes. In others, as in the Northwestern salamander, they are in a single transverse line in front of the orbits. The parasphenoid teeth, when present, are located behind the vomerine teeth and are in a single or double patch (Figure 4). The eye varies in size in the different species, sometimes being large and prominent. Behind the eye in some salamanders is a swollen area, the "parotoid gland." Also present in some, is a fold of skin extending across the throat from the corners of the jaws and known as the "gular fold." No ears are visible.

The trunk is long and somewhat cylindrical in shape and is provided with four legs. The feet of the front pair of legs have four toes each while those of the hind pair have five. Along each side of the body there is sometimes a series of "costal grooves," which indicate the position and number of ribs.

The tail is usually flattened from side to side in species which spend part of their life in water, and during the breeding season the tail of the male may be provided with a prominent fin. In species which spend most of their life on land the tail is round. Vertical grooves may be present along the sides of the tail in both aquatic and terrestrial species.

Unlike a salamander, a frog or toad consists of just two main parts—namely, head and trunk—and the two parts are not separated by a distinct neck (Figure 5). The head is very broad and flattened on top. The mouth is extremely large, extending literally from ear to ear. Inside the mouth is a well-developed tongue which is attached only at the front end, enabling it to be flipped out some distance in the capture of insects and other food organisms. Along the edge of the upper jaw of frogs is a series of small, sharp teeth, while on the roof of the mouth is a second series called "vomerine teeth." Other structures, such as the protuberances of the eyeballs, and openings of the nostrils, gullet, Eustachian tubes, wind-pipe, and vocal sacs in the case of male frogs, may also be seen (Figure 6). Toads are similarly

constructed, except that they lack teeth on the jaw and roof of the mouth. The eyes of both frogs and toads are situated on top of the head and are usually large and protruding. Behind the eyes are the tympanic or ear membranes, which are very large and conspicuous in some members of this group.

The trunk is short and squat. In some species there is a ridge of skin called a "dorsolateral fold" running lengthwise along each side of the back. The front feet are usually short; the hands have four fingers but no webs. There may be tubercles on the palm and the

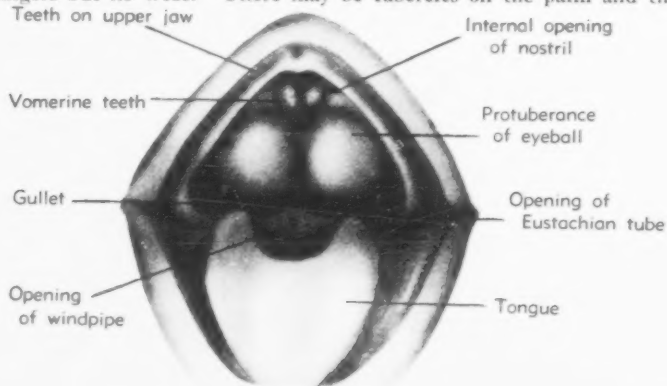


Figure 6. Floor and roof of mouth of a Spotted frog.

thumb may be greatly swollen in the male during the breeding season. The hind legs are longer than the front legs, particularly in frogs. The ankle is much elongated, providing the limb with an extra joint for increased power and flexibility in leaping and swimming. The foot has five long toes, which may be fully webbed in aquatic species. On the lower surface of the hind foot there may be a pair of tubercles. In toads, the inner tubercle is much enlarged to form a digging organ.

The skin may be smooth, roughened with small tubercles, or covered with large warts. In toads, bean-shaped structures called "parotoid glands" are present at the back of the head behind the eyes.

VOICE.

Salamanders are voiceless, but most species of frogs and toads can produce sound. The noise made is a true voice, since it is produced by passing air over vocal cords situated in the larynx of the throat. The ability to produce sound is greatest in males; it is less developed, if not absent, in females.

The voice of most frogs and toads is amplified by means of internal vocal sacs which act as resonators, increasing the volume of the sound many times. In most species a vocal sac is located on each side at the shoulder or in the region of the throat. When these resonators are inflated in the act of croaking the skin of the shoulders or throat may be distended, forming large pouches which expand and contract as air is passed in and out from the lungs. Since the mouth and nostrils are closed during this operation a frog or toad may croak under water.

Each species of frog and toad has a characteristic call which can be used by the experienced listener in identifying the species. Usually the croak consists of a single note which may be repeated in rapid succession as in the Northwestern toad or at longer intervals as in the Spotted frog. In some, the call may consist of two or more notes as in the Bullfrog. The Pacific tree-toad has two types of song, the mating call used in the spring and a less musical croak used in other seasons. The Tailed toad apparently has no voice.

Croaking is more often heard in the spring when frogs and toads congregate in ponds and lakes for the purpose of spawning. At this time, if many frogs or toads are present, a great volume of sound may be produced, the voice of each individual merging in a musical chorus which may carry for considerable distances. This is particularly true of the Pacific tree-toad, which has an unusually powerful voice for its size.

The spring mating chorus of the tree-toad may be heard over a period of several months on the coast, commonly from the end of February to well on in May. In the interior of the Province it commences much later and probably extends into July. The croaking is done principally at night, but it may also be heard during the day, particularly at the height of the breeding season.

NEOTENY.

It has already been stated that metamorphosis may not take place until the second summer or later and that the time of transformation may depend to some extent upon living conditions. In some individuals of some salamander species, however, it is now known that metamorphosis may not take place at all and in such cases the larvæ may grow to a large size and may even reproduce without assuming the usual adult characters. This phenomenon is called "neoteny"; it occurs in the case of the Northwestern salamander (*Ambystoma gracile*) and the Tiger salamander (*Ambystoma tigrinum*) of this Province. A related form of the Tiger salamander lives in the larval stage in lakes near Mexico City, where it is known as the "axolotl" and is used by the natives as food.

The discovery of neoteny among amphibians has given rise to many interesting experiments which have been designed to try to discover the factors which regulate the change from youth to adulthood. In some tests, larval salamanders which were fed thyroid extract rapidly lost their gills and became adults, suggesting that the activity of the thyroid gland probably controls the process of metamorphosis.

POWER OF REGENERATION.

Many animals low in the scale of life, such as worms and crabs, have the ability of growing new legs or even portions of the body which are lost by accident, but this power is usually absent in vertebrates. In amphibians, however, the power of regeneration is highly developed. Frog tadpoles and salamander larvæ, for example, may replace completely a tail or leg that has been bitten off, and the ability is even retained in adult salamanders. This is demonstrated by the Red salamander (*Ensatina eschscholtzi*) found in this Province, which appears to be able to grow a complete new tail should the original one be lost.

In adult frogs and toads the complete regeneration of a part such as a leg is very rare.

POISONOUS QUALITIES.

In general, salamanders, frogs, and toads may be said to be poisonous because their skin gives off substances which are harmful when

swallowed. These secretions are produced by glands which are most numerous in the parotoid region of toads and certain salamanders, or along the lateral folds of frogs, but which may be scattered in other parts of the skin as well.

Two types of glands are present. One type produces a slimy substance which serves chiefly in keeping the skin moist as an aid to respiration, but which also is said to be of protective value since it contains an alkaloid which acts as a narcotic. The second type of gland gives off a milky secretion which is acid in character, acting upon the heart and nervous system when swallowed.

The protective value of these skin secretions lies in the fact that they probably prevent amphibians from being eaten by many animals that would otherwise prey upon them. As an example of the result

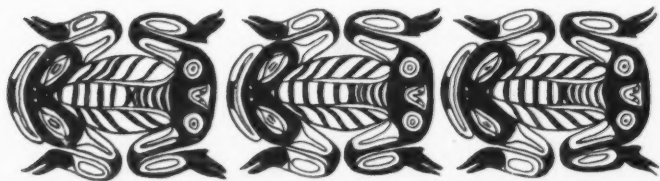


Figure 7. Blanket border of frogs from drawing by Charlie Edensaw, Haida Indian, Masset, Q.C.I.

of the extremely disagreeable nature of these substances, it may be pointed out that a young dog seeing a toad for the first time may pick it up in its mouth, but will usually drop the toad quickly and will not repeat the act. Some animals, however, such as snakes and birds, seem to be immune to amphibian poison and are able to eat salamanders, frogs, or toads with no apparent discomfort. The poison is harmless to man unless it is carried to the mouth or eyes, where it may set up a local irritation.

SUPERSTITIONS.

Salamanders, perhaps more than any other creatures except toads, have been looked upon by man in the past as having magical powers or highly poisonous qualities. For centuries tales have been told of the

marvellous ability of these amphibians to withstand the effects of fire and as a result many technical uses of the word "salamander" have arisen in connection with instruments used around fires. Their supposed highly poisonous qualities are no doubt based on the fact that the skin is cold to the touch and gives off substances mildly distasteful when handled.

Of the tailless amphibians, toads have suffered most at the hands of superstitious persons. In the past many of these harmless animals have been killed, probably as the result of exaggerated tales regarding their poisonous qualities. Even at the present time there are persons who believe that toads have the power of transmitting warts to those who handle them—an opinion no doubt based on the warty character of the toad's skin. It is also held by some that toads are able to live for long periods entombed in rock without food or water. The basis for this impression probably lies in the fact that these amphibians are sometimes discovered hibernating in rock crannies or in subterranean holes. Stories concerning the jewel carried in the head of the toad doubtless are founded on this animal's brilliant golden eye. In spite of the fact that these beliefs have been demonstrated as being false, these harmless creatures are still regarded with fear and distrust by many persons.

Frogs in general have fared better among superstitious persons for they have often been regarded as good luck charms and hence have not been molested. However, among some primitive races, frogs were thought to be custodians of water and as a result they were sometimes sacrificed in attempts to end prolonged dry spells. On the other hand, the Thompson River Indians of the interior of British Columbia believe that killing a frog causes rain and consequently they probably avoid harming these amphibians when they wish continued dry weather.

AMPHIBIANS IN NATIVE FOLK-LORE AND ART.

Among the Indians of British Columbia, amphibians played a conspicuous part in folk tales and other tribal legends; this is particularly true of the frog, of which there are many tales and which is often represented in totem-poles and other handicrafts.

It is interesting to note the prominence given to frogs in the legends of some of the native tribes of this Province. For example, a resident among the Haidas of the Queen Charlotte islands wrote that these Indians considered the frog to be the embodiment of wisdom, whence the Shamans or Medicine men obtained their power from their favourite spirits. Another retailer of Haida myths reports that the Thunderbird had as guards in his celestial kingdom two large frogs whose duty it was to croak loudly and thus give warning of the approach of strangers. They served also as messengers and prevented birds and other creatures from disturbing their employer's rest. Possessed of far-carrying voices they could act as guides for travellers along the dangerous coasts of the islands in foggy weather and the fierce grizzly bear was believed to be afraid of them. Further reference to the protective powers is found in the reason given for the frequent carving of frogs on totem-poles, where their presence prevented the destruction of these poles by jealous persons or enemies of the tribe.

One legend referring to the origin of the Frog Crest traces it to the appearance of a most important chief at a great potlatch to which he had been summoned, with a necklace of live frogs tied leg to leg; since that time his family adopted this creature as their crest. The frog was also the principal crest of the Haida Chief Edensaw, who is perhaps the best known member of this tribe. The use of the frog motif in a design for a blanket border is shown in Figure 7.

To-day, the Frog Crest is nearly universal among some Tsimshian Clans on the Skeena river, and it is said to be the oldest emblem owned by certain families.

Salamanders do not appear to be represented to the same extent in native folk-lore and art, perhaps because they are not so conspicuous as frogs. It is said that the Indians of the Driftwood river region of central British Columbia call the Long-toed salamander the one with "gold on its back" because of the greenish-yellow colour pattern. Mr. and Mrs. Stanwell-Fletcher (1943) report that these natives believe that to touch or to kill this amphibian would mean the loss of money and all worldly possessions. The Interior Salish Indians of the Nicola valley region believe that a "lizard" (possibly the Long-toed salamander) which is known to occur in certain lakes of the

district will follow a man all day and at night will enter his body to eat his heart so that the man dies!

DISTRIBUTION.

It is common knowledge that the various species of animals and plants are not distributed evenly over the face of the earth. Each species tends to occupy a more or less well-defined portion of the earth's surface; sometimes the area occupied is large, covering, perhaps, a whole continent, but in many cases it is small, not extending beyond a plain, a mountain range, or a valley.

The factors which limit the distribution of living things to these areas are not always clear, but as a rule they include climate, food-supply, presence or absence of enemies, means of dispersal, and geographic barriers, such as mountain ranges, rivers, and the sea. In the case of amphibians the most important factors are probably temperature, availability of water, and presence of geographic barriers.

With regard to temperature it must be pointed out that amphibians, being cold-blooded, are greatly affected by heat and cold. As a consequence, they are active only so long as the temperature remains within certain narrow limits; temperatures much above these limits result in death, while temperatures below this range cause them to become torpid. Amphibians can avoid extreme temperature conditions to some extent by retiring to damp burrows or to other cool places during hot summer days, and by hibernating under shelter during the cold winter months.

Of the two temperature extremes, hot and cold, the latter probably exerts the greater influence on the distribution of amphibians, particularly when it is of long duration. As an illustration of the effects of cold it may be noted that at temperatures just above freezing a toad is so slowed down in its reactions that it is unable to capture food. From this it can be seen that under conditions of continued low temperatures toads and other amphibians would perish from starvation, even if food were present.

Therefore, it is not surprising to learn that few amphibians are found in the northern portion of British Columbia which lies in latitudes of low mean temperature. Similarly it is not surprising to find that the northernmost limits of distribution of several North American amphibian species appear to lie within this Province. In fact, of

the species found in British Columbia and southward, all but a few reach the most northern point of their range within this Province. The exceptions are the Pacific newt, the Northwestern toad, the Spotted frog, and possibly one or two others which are found as far north as the Alaskan coast.

Low temperature conditions, similar to those found in northern latitudes, are found on the higher mountain-tops and this may explain the absence of amphibians in these areas.

As noted in a foregoing section, amphibians are dependent to a great extent upon the presence of water, both as moisture in their surroundings and as a place in which to breed and spend their larval life. Terrestrial species which do not spawn in water nevertheless require moist surroundings in which to live and breed. As a result of this dependence upon the presence of moisture, most amphibians are confined to areas where water is readily available, such as near swamps, ponds, lakes, and streams, or in shady, damp woods. The exceptions are the Northwestern toad which is able to wander some distance from water, and the Spade-foot toad which is found in extremely dry country such as in the southern Okanagan valley. In the latter case, however, the toad is able to obtain moisture by digging below the surface of the soil. Both species of toads, of course, must resort to water in order to spawn and as a result they are usually found not far from their breeding-grounds.

With regard to the part played by physical barriers in the distribution of amphibians it is self-evident that features such as mountain ranges, dry plains, and the sea may bar certain of these animals from areas which otherwise they would inhabit. Thus, many of the species found in British Columbia and in other parts of the Pacific coast are not found east of the Rocky mountains and, conversely, few eastern species are represented west of this mountain range. As an example, the Pacific tree-toad is found only west of the Rockies while a related species, the Swamp tree-frog, is found only east of this divide in the Peace River district. Similarly, the Red-legged frog appears to be found only west of the Cascade range.

Regarding the influence of arms of the sea upon distribution, little can be said because so little is known concerning the presence or absence of amphibian species in the coastal area of this Province. It

is true that certain species which occur on the mainland appear to be absent from some of the smaller islands, but in many cases this may be the result of insufficient collecting.

It is necessary to point out, of course, that salt water is a real barrier because no amphibian can withstand immersion in it. This adds to the difficulties in seeking an explanation as to how certain species become established on the islands of this coast. This interesting phase of the study of distribution will not be dealt with here.

In concluding this section we may say that the distributions of the species of amphibians in British Columbia are not well known. It is true that the general range of most species has been determined, but since many portions of the Province are yet to be explored further collecting will undoubtedly extend our knowledge in this field and possibly will also add more names to the list. Thus Slater's frog, *Rana cascadae* (see Slater, 1939, and Wright and Wright, 1942), and the Olympic salamander, *Rhyacotriton olympicus*, which are both found in the State of Washington, are likely to be found in British Columbia when more intensive collecting is done. However, because most of the least-known territories lie north of latitudes in which conditions are suitable for habitation by amphibians, explorations in these areas are not likely to add greatly to present knowledge.

ECONOMICS.

The chief value of amphibians to man is probably biological, because they form a valuable source of material for research-workers. The eggs of both salamanders and frogs are admirably suited for the study of early stages in animal development, since they are large and easily obtained. The larval stages provide excellent opportunities for the study of growth, regeneration, metamorphosis, etc., while the adults, particularly frogs, are used extensively in physiological experiments and for the study of anatomy.

In addition to these varied uses, amphibians are of considerable economic importance from the standpoint of destroyers of insects. All species feed largely on insects, including many of those which are harmful to man, such as wireworms, termites, flies, various types of grubs, earwigs, etc. The outstanding amphibian in insect-pest control is the toad, which forages over a greater area than most sala-

manders and frogs and which consumes large numbers of organisms each night.

As food for man the larger species of frogs are of some commercial importance. In fact, marketable frogs command such a price that in some parts of North America they are reared on "farms" to supply the restaurant trade. The species most commonly used as food is the Bullfrog, but others such as the Green frog, Leopard frog, and Red-legged frog may also be utilized.

Moreover, amphibians make interesting pets, living many years in captivity and becoming tame enough to feed from the hand. Most species may be easily kept in suitable containers in the class-room where they may be used for demonstrations in the teaching of natural history.

ACKNOWLEDGMENT.

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USE OF KEYS AND NOTES.

To aid in the identification of amphibian species known to occur in this Province two "keys" are included in this booklet, one for the salamanders and one for the toads, tree-toads, and frogs. In using a key start with the first line, numbered 1, checking the features listed with those of the specimen to be identified. If the description fits pass on to the statement following, but if the characters do not apply pass on to the alternative statement the number of which is given in parentheses. Proceed in this way until the name of the animal is reached.

Since a key enables a specimen to be identified more or less provisionally the identification should be checked by means of a more

detailed description. This is made possible by the series of notes following each key. These give the outstanding features in structure and colour of each species, together with a short account of the distribution and habits or life-history. In addition, the account of each species is accompanied by an illustration showing some of the characters referred to in the description.

The notes are arranged in what is sometimes called a "natural order"; that is, with those of the most primitive forms at the beginning and those of the most specialized species at the end of the list. The keys are not arranged in this order in all cases.

For further descriptive details the reader is referred to the literature listed at the end of this booklet. This bibliography contains every known published account dealing as a whole or in part with the amphibians of British Columbia. In addition, it lists other publications containing information about species found in this Province.

KEY TO ADULT SALAMANDERS OF BRITISH COLUMBIA.

- 1 (2) Skin usually rough; no costal grooves; under-parts yellow or orange
Pacific Coast Newt (*Triturus granulatus*).
- 2 (1) Skin smooth; costal grooves evident; under-parts not yellow nor orange
- 3 (6) Parotoid glands present
- 4 (5) Parotoid glands prominent; 10 costal grooves
Northwestern Salamander (*Ambystoma gracile*).
- 5 (4) Parotoid glands less prominent; 11 or 12 costal grooves
British Columbia Salamander (*Ambystoma decortecatum*).
- 6 (3) Parotoid glands absent
- 7 (8) Toes ending in horny claws; light areas on dark network
Tiger Salamander (*Ambystoma tigrinum*).
- 8 (7) Toes not ending in horny claws; no light areas on network
- 9 (10) Irregular greenish-yellow band or series of blotches on back
Long-toed Salamander (*Ambystoma macrodactylum*).
- 10 (9) No such greenish-yellow markings on back
- 11 (14) Marbled with brown, grey, or black on dark background
- 12 (13) Large (over 5 inches in length); tail flattened
Pacific Giant Salamander (*Dicamptodon ensatus*).
- 13 (12) Small (under 5 inches in length); tail round
Clouded Salamander (*Aneides ferreus*).
- 14 (11) Not marbled with brown, grey, or black on dark background
- 15 (16) Colour uniform pinkish-red; constriction at base of tail
Red Salamander (*Ensatina eschscholtzi*).
- 16 (15) Colour not uniform, usually reddish or yellowish dorsal stripe; no constriction at base of tail
Red-backed Salamander (*Plethodon vehiculum*).

FAMILY SALAMANDRIDÆ.



PACIFIC COAST NEWT.

Triturus granulosus granulosus
(Skilton).

Description.—General form stout. Total length from 6 to 7 inches. Tail flattened side to side, especially so in the breeding season. No parotoid gland. Eyes moderate. Legs stout and well developed. Costal grooves not evident. Cloacal region enlarged, particularly at spawning-time. Skin rough, but when found in water at spawning-time the skin may be smooth, with a few wrinkles.

Colour above, uniform dark brown or reddish-brown. Lower surfaces, orange or pale yellow.

The Pacific Coast newt may be recognized by its rough skin, flattened tail, and yellow or orange colour on the under-parts.

Distribution.—Along the Pacific coast from Alaska to northern California.

In British Columbia this newt is found throughout the length of the Province, in the southern part east at least to the watershed divide in the Cascade mountains and west to include Vancouver island and certain other coastal islands.

Habits and Habitat.—This newt is the most common tailed amphibian in British Columbia. It is most likely to be seen in the spring, when it congregates in ponds and small lakes to spawn. At this time of year it migrates in such large numbers that it sometimes attracts the notice of the general public, as occasionally happens in Stanley Park, Vancouver, where many newts, bound for Beaver lake, are killed in crossing the highway.

During the spawning season the males possess a well-developed fin around the tail and the skin becomes smooth to the touch. Mated pairs are commonly seen, the male clasping the female behind her fore legs and nudging her head at intervals with his chin.

The eggs measure about one-eighth inch in diameter and are laid singly, attached to water-plants or other submerged objects. The larvæ change to the adult form in late summer, when they are about $1\frac{3}{4}$ inches long.

Juveniles and adults are occasionally found under bark of rotting logs or in other damp places, but seldom far from water.

FAMILY AMBYSTOMIDÆ.



LONG-TOED SALAMANDER.

Ambystoma macrodactylum Baird.

Description.—Body moderately stout. Total length about $4\frac{1}{2}$ inches. Tail conical, flattened toward the end. No parotoid gland. Eyes prominent and widely spaced. Legs well developed with long digits. Costal grooves usually twelve, not continued across belly. Skin smooth.

Colour of the back brownish-black with a conspicuous greenish-yellow irregular stripe or series of disconnected blotches extending from the back of the head to the tip of the tail. Top of the head and upper surfaces of the limbs with small yellowish spots. Lower surface brownish-black, densely speckled with light grey.

The Long-toed salamander may be distinguished from all other British Columbia tailed amphibians by the stripe or series of blotches of greenish-yellow on the back.

Distribution.—Widely distributed in the Northwest from British Columbia south to northern California and east through Alberta, Montana, Idaho, and Iowa.

In British Columbia it is found on the mainland north at least to the Stikine river and east to the Rockies. On Vancouver island it is not common, being known at present only from Langford, near Victoria, and Forbidden Plateau. It may be found at some altitude, as

made evident by the fact that Mr. Hugh B. Leech, of the Dominion Entomological Laboratory, Vernon, B.C., reports collecting a specimen of this salamander on the top of Mount Seymour (altitude 4,758 feet), near Vancouver, on May 31st, 1931.

Habits and Habitat.—This salamander is terrestrial, except in the early spring when it appears in ponds of standing water to breed. The eggs are larger than those of the Tree-toad and each is surrounded by a distinct coat of jelly. They are attached in clumps to a twig or other support and hatch in about two weeks. On the coast the larval period lasts about four months and the size at transformation is about $2\frac{1}{2}$ inches. In higher altitudes most of the larvæ do not transform until the beginning of the second year.

FAMILY AMBYSTOMIDÆ.



NORTHWESTERN SALAMANDER.

Ambystoma gracile (Baird).

Description.—General form stout. Total length $5\frac{1}{2}$ to 8 inches. Tail oval, flattened toward the end. Parotoid glands prominent. Eyes small. Legs strong and well developed. Ten conspicuous costal grooves, continued across belly. Skin slightly roughened.

Colour above, uniform dark brown to black, sometimes with small yellowish spots. Under-parts uniform grey or dark grey.

The Northwestern salamander is most likely to be confused with the British Columbia salamander, from which it differs in having more prominent parotoid glands and ten costal grooves.

Distribution.—South from British Columbia to northern California.

In British Columbia this salamander is found chiefly in the southwestern portion, including Vancouver island and other coastal islands from sea-level to timber-line. On the mainland coast it ranges at least as far north as Prince Rupert.

Habits and Habitat.—At sea-level the eggs of this salamander are laid in February, March, April, and May in large jelly-like masses about the size and shape of an elongated grapefruit. The egg-masses are readily recognized by the large size and firm jelly. Sometimes they are greenish in colour, due to the presence of a green alga lining the egg-capsules. The larvæ hatch in about one month and spend at least a year in the water. Some metamorphose in the second summer when about $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long. Others remain in the larval stage for an indefinite period and in some cases they may breed without attaining the adult form. These large larvæ which may be found in ponds from sea-level to timber-line often attain a length of $5\frac{1}{2}$ to 6 inches.

FAMILY AMBYSTOMIDÆ.



BRITISH COLUMBIA SALAMANDER. *Ambystoma decortatum* Cope.

Description.—General form stout. Total length about $6\frac{1}{2}$ inches. Tail oval, flattened toward the end. Parotoid glands less pronounced than in *A. gracile*. Eyes small. Legs strong and well developed. Costal grooves eleven or twelve. Skin slightly roughened.

Ground colour dark brown, with numerous white spots of irregular form and size on back, limbs, and tail. Under-surfaces light brown.

The British Columbia salamander differs from the Northwestern salamander in having less prominent parotoid glands and in having eleven or twelve costal grooves instead of ten.

Distribution.—Confined to the coastal wet belt of British Columbia and Washington north at least to Port Simpson.

Specimens of this salamander have been taken in British Columbia at Prince Rupert and others have been recorded from Chillinae valley on Tamitly mountain, Metlakatla, and Bella Coola.

Habits and Habitat.—Nothing is known about the habits of this salamander in British Columbia. Its life-history is probably very similar to that of the Northwestern salamander, its nearest relative.

FAMILY AMBYSTOMIDÆ.



TIGER SALAMANDER.

Ambystoma tigrinum slateri Dunn.

Description.—General form stout. Total length 6 to 8 inches. Tail conical, flattened toward the end. No parotoid gland. Eyes small, prominent and well separated. Legs well developed, toes ending in horny tips. Costal grooves usually twelve or thirteen. Skin smooth but covered with openings of small glands.

Back, sides, and upper surfaces of limbs bear greenish-white areas with indefinite borders on a dark brown background in the form of a network. Under-parts greenish-white, faintly marked with dark bands.

The Tiger salamander is distinguished by its large size, by the horny tips to the toes and by the pattern of greenish-white areas on a dark network.

Distribution.—From British Columbia south to Oregon and east through Alberta to Nebraska.

In British Columbia this large salamander has been taken only at Midway, in the south-eastern portion of the Province, and at Summerland and Osoyoos, in the Okanagan valley.

Habits and Habitat.—Nothing is known of the habits of this salamander in British Columbia. In other parts of its range it is terrestrial during most of the year, living in decaying stumps and in burrows of animals. In the spring it is found in ponds where the eggs are laid in clumps of jelly attached to submerged plants. Hatching occurs in about two weeks, and the larval period lasts for about three months. The larvæ reach a length of 3 to 7 inches and in certain parts of the State of Washington they are used for bait for fishing in the larger rivers.

FAMILY AMBYSTOMIDÆ.



PACIFIC GIANT SALAMANDER. *Dicamptodon ensatus* (Eschscholtz).

Description.—General form robust. Size 6 to 12 inches long. Tail conical, flattened toward the tip. No parotoid gland. Eyes large and bulging. Legs well developed. Toes with terminal knobs. Costal grooves usually twelve. A prominent dorsal groove running from back of head to base of tail. Skin smooth.

Back and sides purplish-brown in colour with dark brown or black mottling. Under-parts light brown or yellowish-white.

The Pacific Giant salamander is most readily recognized by its large size and by the pattern of brown or black marbling on a dark background.

Distribution.—Along the Pacific coast from British Columbia to Monterey bay, California, and east to Idaho.

In British Columbia it has been found only in the extreme south-west portion of the Province, south of the Fraser river, being recorded only from the Chilliwack district.

Habits and Habitat.—Little is known about the life-history or habits of this large salamander. Recent observations in California indicate that the eggs are large and are attached singly by means of a jelly-like stalk to objects submerged in rapidly running streams and that the larvæ attain a size of about 8 inches before metamorphosing in their second summer.

FAMILY PLETHODONTIDÆ.



WESTERN RED-BACKED
SALAMANDER.

Plethodon vehiculum
(Cooper).

Description.—General form elongate and slender. Total length from 4 to 5 inches. Tail round, flattened at the end. No parotoid glands. Eyes prominent and widely separated. Legs short and slender. Costal grooves fourteen or fifteen. Mid-dorsal groove from back of head to base of tail. Skin smooth, roughened on sides.

Ground colour dark brown, with a broad reddish or yellowish band running down middle of back from head to tip of tail. Stripe marked with small dark specks and bordered by a narrow black stripe which merges with the brown of the sides. Under-parts greyish-brown, sometimes marbled with yellowish-white. In some, dorsal stripe only faintly evident.

The Western Red-backed salamander is easily distinguished by its long slender form and conspicuous reddish or yellowish band on the back. Individuals which lack the prominent dorsal stripe may be confused with the Red salamander but may be distinguished by the absence of the constriction at the base of the tail.

Distribution.—Found in British Columbia, Washington, and western Oregon.

In British Columbia it is found in the south coastal portion of the Province, including Vancouver island.

Habits and Habitat.—This salamander, being strictly terrestrial, is never found in water. Like other amphibians, however, it is dependent upon moisture for existence, and consequently is restricted to damp places such as rotting logs in shaded woods. It is most com-

monly found beneath the accumulation of bark, leaves, and rotting wood that is usually present under decaying logs lying on the ground. This salamander can run and jump surprisingly quickly, making it necessary for the collector to be on the alert to make a capture.

The eggs are as large as peas and are laid in grape-like clusters attached to the sides or roof of a hollow space in a moist location. It is likely that the female remains with the eggs during the period of incubation. The developing young pass through a gilled larval stage within the egg and hatch in the adult form. Termites and other soft-bodied insects appear to be the main food.

FAMILY PLETHODONTIDÆ.



RED SALAMANDER.

Ensatina eschscholtzi Gray.

Description.—General form moderately slender. Total length about $4\frac{1}{2}$ inches. Tail round, constricted at the base and with a series of grooves. No parotoid gland. Eyes large and prominent. Legs short and stout. Costal grooves usually eleven. Skin smooth but pitted with openings of small glands.

General colour yellowish- or reddish-brown without markings. Limbs pale orange with light orange patch on dorsal surface near base. Under-parts pale grey or whitish. The whole salamander has a somewhat transparent, fragile appearance.

The Red salamander differs from all others in the Province by having a constriction at the base of the tail and a uniform reddish- or yellowish-brown coloration.

Distribution.—Along the coast from southern British Columbia to lower California.

In British Columbia the Red salamander has been found only in the extreme southwestern portion of the Province, including the lower Fraser valley, Vancouver island, and Gambier island.

Habits and Habitat.—The Red salamander, being entirely terrestrial in habit, never enters the water. It is found chiefly in damp woods under bits of bark, in the debris from decaying logs, etc., and is probably nocturnal. The tail appears to be easily lost since it is not uncommon when handling specimens to have it part from the body at the constriction behind the vent and occasionally individuals are found with a new tail growing from the old stump. Like other terrestrial salamanders, this species lays its eggs in a damp cavity and the young pass through a larval stage before hatching.

FAMILY PLETHODONTIDÆ.



CLOUDED SALAMANDER.

Aneides ferreus Cope.

Description.—General form moderately slender. Total length from 4 to 5 inches. Tail round, with a series of distinct grooves but no constriction at base. Parotoid gland absent. Eyes large and prominent. Line of mouth curved upward behind eyes producing a "smiling" expression. Legs fairly well developed. Costal grooves usually fourteen. Skin smooth.

General colour dark grey or black, conspicuously marbled or mottled on dorsal surfaces with yellowish-grey, sometimes speckled with bronze and with a few small whitish spots. Under-parts steel grey, sometimes with small, light-coloured spots.

The Clouded salamander is easily distinguished by the black and grey mottlings and the "smiling" expression of the face.

Distribution.—From British Columbia to northwestern California.

In British Columbia it has been taken only on Vancouver island and on a few other neighbouring islands.

Habits and Habitat.—Like the two species previously described, the Clouded salamander is strictly terrestrial. It is found in damp woods, under bark, stones, etc., and occasionally some distance above ground in hollow trees. Nothing is known of its life-history in this Province, but it probably resembles the other terrestrial salamanders in this respect.

KEY TO THE ADULT TOADS, TREE-TOADS, AND FROGS OF BRITISH COLUMBIA.

- 1 (4) Ear membrane absent or indistinct; pupil of eye vertical
- 2 (3) No black spade or spur on hind foot; male with a "tail"
Tailed Toad (*Ascaphus truei*).
- 3 (2) Black spade on hind foot; male without "tail"
Western Spadefoot Toad (*Scaphiopus hammondi*).
- 4 (1) Ear membrane distinct; pupil of eye horizontal
- 5 (6) Parotoid gland present; skin covered with warts
Northwestern Toad (*Bufo boreas*).
- 6 (5) Parotoid gland absent; skin smooth or roughened with
tubercles
- 7 (10) Size small; disks on ends of toes
- 8 (9) Disks inconspicuous; five stripes or rows of spots on body;
east of Rockies
Swamp Tree-frog (*Pseudacris n. septentrionalis*).
- 9 (8) Disks conspicuous; spots not in five rows; west of Rockies
Pacific Tree-toad (*Hyla regilla*).
- 10 (7) Size medium or large; no disks on toes
- 11 (18) Ear membrane smaller than diameter of eye
- 12 (15) No red colour on under-parts
- 13 (14) Spots with narrow, light border; no dark patch behind eye
Leopard Frog (*Rana pipiens*).
- 14 (13) Spots with no light border; dark patch behind eye with bar
running forward to snout
Northern Wood Frog (*R. s. cantabrigensis*).
- 15 (12) Red colour on under-parts
- 16 (17) Dorsolateral fold not prominent; skin of back smooth; spots
on back with no light centre; dark patch from eye to
corner of jaw; red on sides of body and under-parts of
fore and hind legs
Red-legged Frog (*R. aurora*).

- 17 (16) Dorsolateral fold prominent; skin of back rough; spots on back with light centres; no dark patch behind eye; red on under-parts of belly and legs but not on sides
Western Spotted Frog (*R. pretiosa*).
- 18 (11) Ear membrane as large as or larger than diameter of eye
- 19 (20) Dorsolateral fold present; sides of head and snout green; last two joints of outer toe free of web
Green Frog (*R. clamitans*).
- 20 (19) Dorsolateral fold absent; no green colour on head; last joint only of outer toe free of web
Bullfrog (*R. catesbeiana*).

THE RIBBED TOADS. FAMILY ASCAPHIDÆ.



TAILED TOAD.

Ascaphus truei Stejneger.

Description.—General form moderately slight. Total length about $1\frac{1}{2}$ inches. Head broader than long. Eyes moderate with vertical pupil. Ear membrane not evident. Parotoid gland elongate, extending from eye to shoulder. Front legs relatively long with long, slender fingers. Hind legs long; toes slightly webbed. In the male, hind-end portion of body produced into a "tail" measuring about $\frac{3}{8}$ inch in length. Skin nearly smooth or moderately rough and wrinkled with a few warts or tubercles over the upper surface and sides of head and body.

Colour above reddish-brown or dark grey, clouded with black. A light line bordered posteriorly with a dark line across head from eye to eye. A dark line on either side of head from snout through eye to corner of jaw. Iris of eye flecked with bright orange-yellow. Upper surfaces of front and hind legs clouded with black; tubercles whitish. Colour of belly yellowish-white; under-surfaces of legs and throat pinkish.

The male Tailed toad may be easily recognized by the conspicuous "tail," a structure found in no other toad or frog. The female is similar to a tree-toad but differs in having vertical pupils and no external ear membranes.

Distribution.—From British Columbia south through Washington and Oregon to California.

In British Columbia the Tailed toad has been collected in the following localities: Cultus lake (near Chilliwack), Cascade creek (north of Hatzic), Sunshine creek (near Woodlands, Indian arm), and from a small stream a few miles south of Lytton. Since this toad appears to be fairly widely distributed it is likely that it will be found in other parts of British Columbia when more intensive collecting is done.

Habits and Habitat.—This rarely-seen toad is most often found in the vicinity of cold mountain streams at altitudes ranging from near sea-level to about 6,000 feet. When disturbed near the water the toad often leaps in and swims to the bottom where it remains motionless, blending with the stones on the bottom of the pool. During wet weather it may roam some distance from the stream.

The eggs are laid during the summer months and are said to be in circular masses of rosary-like strings attached to the under-sides of stones in creeks. They are few in number, colourless and about $\frac{1}{8}$ inch in diameter.

The tadpole is provided with a large sucking disk about the mouth which enables it to cling to stones in swift water. It probably requires two years to reach maturity and metamorphose.

The Tailed toad is interesting biologically because it belongs to a group of amphibians which possesses several characters which are said to be primitive, such as the presence of true ribs. These features are also found in newts and salamanders, indicating that the Tailed toad and other members of the family Ascaphidæ form a connecting link between tailed and tailless amphibians.

The Tailed toad is also interesting from the standpoint of its distribution, since it is the only species of this family found in North America. All the other members of the group are found in western Europe, Asia, and New Zealand.

THE SPADEFOOT TOADS. FAMILY SCAPHIOPODIDÆ.



WESTERN SPADEFOOT TOAD.

Scaphiopus hammondi Baird.

Description.—General form short and squat. Length about $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. Head short, broader than long. Eyes large, prominent, and with a vertical pupil. Ear membrane indistinct, about one-half diameter of eye. No parotoid gland. Front legs moderately stout. Hind legs short and provided with a black, horny spur on inner angle of heel. Toes of hind foot webbed. Skin moderately smooth with small, round warts; smaller tubercles on under-parts.

Colour brown or grey with two or four light-coloured stripes from head to thighs. Warts on upper surfaces dark brown. Under-parts light grey with reddish tinge on thighs and with white tubercles. Skin of under-surfaces somewhat transparent; certain veins and arteries visible. Spur or "spade" of hind foot jet black. Periphery of eye flecked with gold.

The Western Spadefoot toad may be distinguished from the Northwestern toad by the vertical pupil, black spur on the hind foot and lack of the median stripe down the back.

Distribution.—West of the Rockies from British Columbia to Mexico.

In British Columbia it is found only in the Dry Belt, particularly from Osoyoos, at the International border, west to Keremeos and north to Kamloops.

Habits and Habitat.—The Spadefoot toad is one of the least commonly seen of our tailless amphibians, since it spends a great deal of its time underground, emerging only at night. In the spring and early summer the deep croak of the Spadefoot may be heard, often supplying bass notes for the chorus of tree-toads heard at the same season. If the sounds are tracked down at night the toads may be found squatting in the shallow water of ponds or lake-shore where they have gathered for the purpose of spawning. By day a few may be found hiding beneath some shelter, such as a piece of wood or bark along the water's edge. When disturbed on loose soil the toad crouches down, then with a shuffling motion of the hind legs quickly digs itself out of sight. The spur or "spade" on the hind foot is a great help in digging.

The eggs are similar to those of the tree-toad but of a smaller size. The tadpoles can be distinguished from those of other species when half grown by the presence of the spur on the hind legs. Development from egg to transformation appears to be very rapid since breeding often takes place in temporary pools of rain-water.

Except during the spawning season when they are found near water, Spadefoot toads live in the most arid parts of the sage-brush country. Although they are seldom seen their tracks may be found on sand-dunes and other favourable spots, indicating that the toads move about at night in search of food. They probably remain buried during the heat of the day to conserve moisture.

THE TRUE TOADS. FAMILY BUFONIDÆ.



NORTHWESTERN TOAD. *Bufo boreas boreas* Baird and Girard.

Description.—General form short and squat. Length from 2 to 5 inches. Head short with prominent, widely spaced eyes. Pupil of eye horizontal. Ear membrane about three-quarters diameter of eye. Oval-shaped parotoid gland with a narrow neck pointing toward the eye. Front legs relatively long with forearm decidedly longer than foot. Hind legs relatively short; toes webbed to the tips. Skin very rough with large warts in rows along the back and scattered over other parts of body. Small tubercles between the warts. Forefoot with one large and one small tubercle on the palm. Hind foot with fairly large brown spade.

Colour variable, usually dark brown or reddish-brown background mottled with light brown, grey, or green. A conspicuous light-coloured stripe from tip of snout down the mid-line to posterior point of body. Parotoid gland and some warts often tinged with red. Under-parts dull white with dark spots or blotches. Periphery of eye densely flecked with gold.

The Northwestern toad may be distinguished by the warty skin, median greenish stripe, parotoid gland, and short hind legs with a brown spade on the foot.

Distribution.—From Alaska south to northern California and east to Utah and Colorado.

In British Columbia it is found throughout the Province, including Vancouver island, Queen Charlotte islands, and other coastal islands.

Habits and Habitat.—Adult toads congregate in the early spring in swamps and along margins of lakes for the purpose of spawning. At this time the males call with a high-pitched tremulous note, amplified by the vocal sacs distended beneath the chin. The eggs are laid in long strings of jelly hanging in festoons from water-weeds or lying on the bottom in shallow water. The tadpoles which hatch in a few days resemble those of other toads and frogs, except that they are jet black or dark brown in colour. Toad tadpoles have the habit of congregating in large swarms along the water's margin in such numbers they resemble a black cloud slowly changing shape. Sometimes they swim in a narrow band as if playing "follow the leader." Growth is rapid and by the end of the summer the young toads leave the water when only a little over one-half inch long. At this time their numbers may be so large that it is impossible to walk along the lake's edge without treading on toads, and if a highway happens to be near many are killed by traffic while they are crossing the road. Since toads prefer to travel during damp weather they often appear suddenly after a shower, a habit which has probably given rise to the belief that they descend with the rain.

Except during periods of migration, which may be during the day, toads are nocturnal, doing most of their foraging at dusk and into the night. At this time they may wander considerable distances from water but usually retire to some damp hole or shaded spot at dawn. Their food consists largely of insects and other small creeping organisms and, since they are capable of eating large quantities, toads are of considerable value as destroyers of insect pests. For this reason they should be afforded every protection possible and should be encouraged to remain around the garden.

THE TREE-TOADS. FAMILY HYLIDÆ.



PACIFIC TREE-TOAD.

Hyla regilla Baird and Girard.

Description.—General form delicate. Length about $1\frac{1}{4}$ to $1\frac{3}{4}$ inches. Head flat with prominent eyes. Ear membranes about one-half diameter of eyes. Parotoid gland absent. Fold of skin across breast between attachment of front legs. Fore and hind legs of moderate length; fingers and toes ending in round disks. Toes of hind legs webbed for half their length. Skin moist and covered with minute tubercles.

Coloration highly variable. Ground colour brown, bronze, green, or grey. A dark band underlined by a lighter stripe usually from nostril backward through eye and ear to shoulder. Dark, elongated blotches usually present on back and limbs and a Y-shaped blotch often found on top of head, the two arms extending over the eyes, the stem pointing backward. Eye with a bronze iridescence. Under-parts whitish and occasionally salmon coloured. Some specimens lack the darker pattern except the dark band through the eye. All are capable of changing colour to some extent.

The Pacific tree-toad is readily recognized by the conspicuous disks on the toes and by the dark band on the cheeks.

Distribution.—From British Columbia to California and east to Idaho and Utah.

In British Columbia it is found chiefly in the south central and south-western part of the Province, including Vancouver island and adjacent islands.

Habits and Habitat.—The tree-toad is one of our best known amphibians. It congregates in some numbers each spring in almost every pond and swamp and starts up a chorus of loud croaking which may be heard great distances. Only the males croak. In spite of their small size the sound is extremely loud, being amplified by a resonating sac which, when fully expanded, swells the throat to a size three times as large as the head. The individual call appears to consist of two notes, sounding much like the phrase "wreck it." The croak is repeated at intervals of two or three seconds and may continue through the night and part of the day during the spawning season. At some distance the notes blend into a chorus which is quite melodious.

The eggs are laid in February, March, and April on the coast but much later, probably June and July, in the interior of the Province. They usually number twenty to fifty and are enclosed in small clusters of jelly attached to grass stems or other similar supports. The tadpoles develop rapidly so that on the coast young tree-toads are ready to leave the water by mid-July. In exceptionally dry years large numbers perish when ponds become dry before metamorphosis has been completed.

After leaving the water tree-toads spend most of their life in shrubs and trees. Here they climb with ease, leaping from place to place and clinging to smooth surfaces, such as shiny leaves, by means of the adhesive pads on the toes. Their main food items are various insects which they catch with great skill by means of their sticky tongues. The male's croak at this time is a grating sound not unlike the noise produced by dragging the finger-nail over a few inches of fly-screening. Since tree-toads do not hibernate during mild winters on the coast they may be heard croaking in all months of the year.

THE TREE-TOADS. FAMILY HYLIDÆ.



SWAMP TREE-FROG.

Pseudacris nigrita septentrionalis
(Boulenger).

Description.—General form delicate. Length about 1 inch. Head narrow. Eyes moderate with horizontal pupil. Ear membrane small, less than one-half diameter of eye. No parotoid gland. Dorsolateral folds indistinct. Front and hind legs slender and short. Toes ending in very small disks. Hind toes with small webs. Skin of upper parts smooth with a few small tubercles; under-parts granular.

Colour from grey to buff. In lighter individuals a faint stripe from region of eye to groin on each side and one down middle of back. In some, stripes broken into a series of spots. Legs faintly barred. Under-parts creamy white.

The Swamp tree-frog is most readily recognized by its small size, narrow head, and small pads or disks on the toes.

Distribution.—Canadian northwest, Minnesota to Montana.

In British Columbia it is known to occur in the Peace River district.

Habits and Habitat.—The Swamp tree-frog is said to breed from May to early June. The eggs, which are small, are in an irregular jelly mass attached to vegetation. The tadpoles transform when less than one-half inch in length.

In the Peace River district of British Columbia they were found to be abundant and in full song during May and June in flood pools at Tupper creek and in marshy backwaters of the North Pine river at Charlie lake.

THE TRUE FROGS. FAMILY RANIDÆ.



RED-LEGGED FROG.

Rana aurora aurora Baird and Girard.

Description.—General form moderately slender. Length 2 to 3½ inches. Head broader than long. Eyes moderate with horizontal pupil. Ear membrane small, about one-half diameter of eye. No parotoid gland. Dorsolateral fold not prominent. Front and hind legs long and slender. Heel of hind leg when extended forward extends beyond the snout. Hind toes fully webbed. Skin smooth, sometimes with small tubercles, particularly on thighs.

Colour above light brown, sometimes with reddish tinge, and usually with small, irregularly shaped dark spots on head and body. A dark patch from eye to corner of jaw and a light line along upper jaw from a point below eye to skin-fold behind angle of jaw. Hind legs may be speckled or barred with dark brown. Under-parts light with dark mottlings. A conspicuous red coloration on side of body and under-surfaces of fore and hind legs.

The Red-legged frog may be recognized by its slender form, smooth skin, dark patch behind the eye, and red colour on sides of body and under-surfaces of legs.

Distribution.—Along the Pacific coast from British Columbia to extreme northwestern California.

In British Columbia the Red-legged frog is known only from the south coastal region, west of the coast mountains, including Vancouver island.

Habits and Habitat.—The Red-legged frog is an inhabitant of woods, banks, and streams, and edges of lakes. In these surroundings it is usually seen only when it is disturbed, at which time it may leap a considerable distance into the water and swim rapidly to the bottom. After a time, if the observer is patient, the frog may be seen floating to the surface and may be easily taken in a net.

Little is known of the life-history. The eggs are laid in masses during March and April in backwaters of lakes and streams. Tadpoles collected in a lake near Victoria, B.C., on May 9th, 1941, when about 1 inch in length, transformed in July of the same year.

The adult when kept in captivity is very timid. At first it may remain hidden for long periods, but it soon learns to take worms and insects and becomes reasonably tame. Two specimens, kept in a vivarium at the Provincial Museum, Victoria, B.C., lived in captivity for eleven and thirteen years respectively.

THE TRUE FROGS. FAMILY RANIDÆ.



WESTERN SPOTTED FROG.

Rana pretiosa pretiosa Baird
and Girard.

Description.—General form moderately stout. Length $2\frac{1}{2}$ to $3\frac{1}{2}$ inches. Head broader than long. Eyes moderate with horizontal pupil. Ear membrane small, about one-half diameter of eye. Vomerine teeth in short, oblique series between or a little behind inner opening of nostril. No parotoid gland. Dorsolateral fold fairly prominent. Front and hind legs moderately long and slender. Heel of hind leg when extended forward falling short of snout. Hind toes fully webbed. Skin rough with small tubercles on back and thighs and larger tubercles on sides of body.

Colour above usually light or dark brown with moderately large, irregularly shaped dark spots on head and body. Spots sometimes with light centres. No dark patch behind the eye. Fore and hind limbs with dark cross-bars. A light-coloured streak along upper jaw from snout to skin-fold behind angle of jaw. Under-surfaces creamy white, sometimes with a darker mottling. Most specimens, particu-

larly large individuals, with rich salmon or red colour on under-surfaces of legs and belly but not on the sides.

The Western Spotted frog can be recognized by its stout form, rough skin, and by the presence of dark spots with light centres on the back and salmon or red colour on the under-parts only.

Distribution.—Alaska south to northern California and east to Utah and Montana.

In British Columbia the Western Spotted frog is widely distributed from Lake Bennett in the north, south to the International boundary and from the Rocky mountains west to the summit of the Cascade and coastal mountains. It has not yet been found on the coast nor on the coastal islands but it occurs in a few localities in the lower Fraser valley.

Habits and Habitat.—The Spotted frog is almost entirely aquatic, spending most of its time in or close to the water. At Westbank on Okanagan lake, B.C., this frog was seen in some numbers in a large roadside pond during the first week of June, 1941. Since no eggs or tadpoles were observed it is probable that the frogs had not yet commenced breeding. Spawning probably takes place in the interior of the Province in June and July and the tadpoles probably winter over and metamorphose the following summer.

In eastern Washington this frog appears in late February and breeding takes place during March and early April. At this time the frogs give out short bass notes which are easily distinguishable from the higher-pitched croak of the tree-toad. The eggs, numbering 1,100 to 1,500 in a mass, are laid in shallow water and hatch in about four days. The tadpoles grow rapidly and metamorphose in this area by the middle of June. Two years are probably required for the frog to reach maturity.

THE TRUE FROGS. FAMILY RANIDÆ.



NORTHERN WOOD FROG.

Rana sylvatica cantabrigensis Baird.

Description.—General form moderately slender. Length $1\frac{1}{2}$ to $2\frac{1}{4}$ inches. Head about as broad as long. Eyes moderate with horizontal pupil. Ear membrane small, diameter less than eye. Vomerine teeth in two small rounded groups between the inner openings of nostrils. No parotoid gland. Dorsolateral folds moderately prominent. Legs slender and long. Hind toes fully webbed. Skin smooth.

Colour above from yellowish-grey to dark brown. Two light-coloured stripes on dorsolateral folds and a light line usually from snout to anus. Usually a triangular black patch covering the ear and a bar through eye to snout. A light stripe borders upper jaw. Dark spots on back and sides. Occasionally dark spots are elongated and have a light centre. Legs barred or spotted. Under-parts creamy white to yellowish, sometimes with dark mottlings on throat and breast.

The Wood frog may be distinguished from other frogs in British Columbia by the presence of the dark triangular patch behind the eye, the light-coloured dorsolateral folds and by the absence of red colour on the under-parts.

Distribution.—From Michigan westward to Minnesota, northward through Canada to Great Slave lake, British Columbia and Alaska.

In British Columbia it is found in the wooded northern portion, south in the west to the vicinity of Clinton.

Habits and Habitat.—The Northern Wood frog is the "most abundant and widespread amphibian of the Peace River district.

Spawning started at Tupper Creek on May 9th, 1938. On this date the low-pitched croaking, of remarkable intensity and carrying quality was heard at our camp a mile from the spawning pond. The species 'swarms' during breeding activities. We found several aggregations of from twenty to sixty individuals in areas of not more than ten square feet of water surface. There was no apparent reason for the choice of these particular spots on an homogeneous lakeshore, but at these points the egg masses covered the bottom, lying one upon the other in the shallow water, quite unattached to the substratum. After spawning the frogs left the water under the protection of the first rain and spread out over the surrounding country.

"At Swan Lake and in Tupper Creek these frogs were very seldom seen along the margins of the main lake and the lower reaches of the river while at Charlie Lake they were abundant in the grass along Stoddart Creek and adjoining the lake. Possibly the large numbers of pike in the first locality and the absence of this fish from the latter water bodies serves to explain the different behaviour of the frog population." (Cowan, 1939, pp. 92-93.)

THE TRUE FROGS. FAMILY RANIDÆ.



LEOPARD FROG.

Rana pipiens Schreber.

Description.—General form slender. Length $2\frac{1}{4}$ to 4 inches. Head about as broad as long. Eyes moderately prominent, with horizontal pupil. Ear membrane medium, diameter less than eye. No parotoid gland. Prominent dorsolateral fold from eye to thigh. Front legs heavy. Hind legs moderate in length and with fully webbed toes. Skin generally smooth with small tubercles on back and thighs.

General colour brown, grey, or green, with large black or dark brown spots on head, body, and legs. Spots usually oval in shape and with a light-coloured border. A light line along upper jaw, below ear, to point above arm. Under-parts yellowish or white.

The Leopard frog may be recognized by its slender shape and the presence of light borders to the dark spots.

Distribution.—Throughout most of North America east of the Cascade mountains.

In British Columbia it has been taken so far only at Loon lake, 12 miles north of Newgate.

Habits and Habitat.—The Leopard frog is found mainly in swampy areas, backwaters of streams and in ponds in the spring, and in grassy woodlands and fields in the summer. Nothing is known of its habits in British Columbia.

THE TRUE FROGS. FAMILY RANIDÆ.



BULLFROG.

Rana catesbeiana Shaw.

Description.—General form stout. Length 3 to 8 inches. Head about as broad as long. Eyes moderate with horizontal pupil. Ear membrane large, twice the diameter of the eye in the male, about equal in the female. No parotoid gland. A prominent fold over and behind ear. No dorsolateral fold. Front and hind legs stout. Toes of hind foot fully webbed, except last joint of outer toe. Skin smooth or roughened with small tubercles.

Colour above greenish, yellowish, or brownish-olive with or without distinct or connected spots. Legs spotted or barred with dark. Under-parts whitish, sometimes with dark marbling. Throat yellowish in the male.

The bullfrog may be recognized by its large size and large ear membranes. It can be distinguished from the Green frog by the absence of both the dorsolateral fold and the green mask.

Distribution.—Throughout North America east of the Rockies.

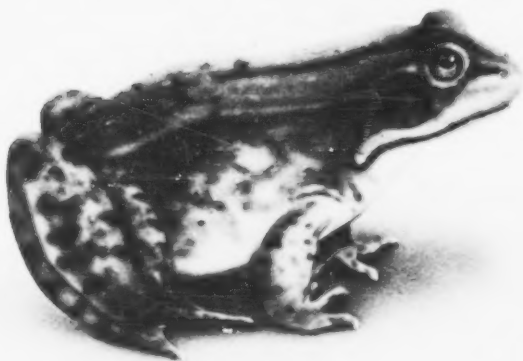
In British Columbia it is known only from a few localities such as Burnaby lake and tributary streams, where it is now established, having escaped from artificial ponds or from "frog farms."

Habits and Habitat.—In its natural range the bullfrog is found in swamps, ponds, and lakes where plenty of cover and some deep water is present. It is almost entirely aquatic, spending all its life in the water, going ashore only on rare occasions.

In the breeding season during early summer the deep bass notes of the males may be heard over a considerable distance. The eggs are laid in a large mass floating at the surface of the water and the tadpole may spend two winters before metamorphosing.

Some tadpoles, collected in July in the vicinity of Vancouver, B.C., were 6 inches in length and just growing the hind legs. They are distinctively coloured, dark green above, sulphur yellow beneath, with many fine black spots on the tail-fin.

THE TRUE FROGS. FAMILY RANIDÆ.



GREEN FROG.

Rana clamitans Latreille.

Description.—General form stout. Length 2 to 4 inches. Head about as broad as long. Eyes moderate with horizontal pupil. Ear membrane large, twice the diameter of the eye in the male, about equal in the female. No parotoid gland. Dorsolateral fold prominent and with a branch running downward behind the ear. Front and hind legs moderately stout. Hind toes fully webbed except last two joints of outer toe. Skin roughened with small tubercles.

Colour above chocolate brown or greenish-brown, sometimes with a few rounded spots on back and sides. Sides of head from ear to snout often a bright green. Ear membrane with a greenish-yellow spot in the centre. Lower parts of sides of body with dark bars, particularly in the female. Legs with dusky bars. Under-parts creamy white. Throat of male yellow-green or orange-yellow.

The Green frog may be distinguished from all other frogs by the large ear membranes, the green mask on the face, and the yellow throat in the male. It differs from the bullfrog, which also has large ear membranes in the presence of a prominent dorsolateral skin-fold.

Distribution.—Eastern North America from Hudson bay to Gulf of Mexico.

In British Columbia at the present time it is found only in a few ponds in the vicinity of Victoria, where it has escaped from artificial garden-pools.

Habits and Habitat.—Little is known of the habits of the Green frog in this Province. In eastern North America it may be found along watercourses, in swamps, reservoirs, and ponds of all sizes. The eggs, laid in late spring or mid-summer, float at the surface of the water. The large tadpoles metamorphose in the following year. A tadpole of this species which was collected in March, 1941, in an artificial pond a few miles north of the city of Victoria, B.C., metamorphosed in May. It probably hatched the previous season, spending the winter as a larva.

Although the Green frog does not attain as large a size as the bullfrog it is often collected and sometimes reared to supply the market with frogs' legs. The tadpoles are also extensively sold in pet shops, chain stores, aquatic gardens, etc., along with goldfish and water-weeds. The Green frogs now found in the vicinity of Victoria owe their origin to tadpoles imported for this trade.

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ADDENDUM.

While this booklet was in press further information has been received regarding the status of the British Columbia salamander, *Ambystoma decortdatum*. After examining fresh material from British Columbia, Dr. E. R. Dunn concludes that *A. decortdatum* is an ill-defined northern race of *A. gracile*, the Northwestern salamander. Thus he considers all specimens from Vancouver island and from the southern part of the mainland as typical Northwestern salamanders (*A. gracile gracile*), while those from the northern islands and northern part of the mainland form a subspecies, *A. gracile decortdatum*.

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